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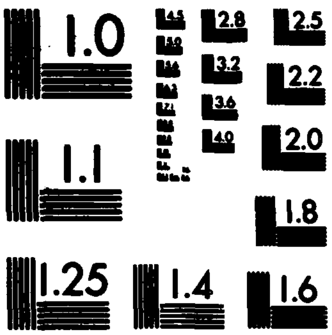

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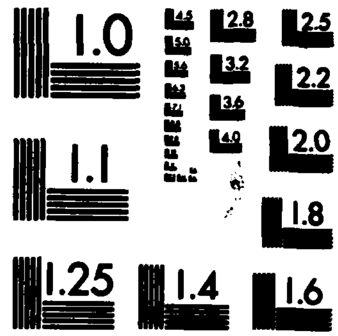

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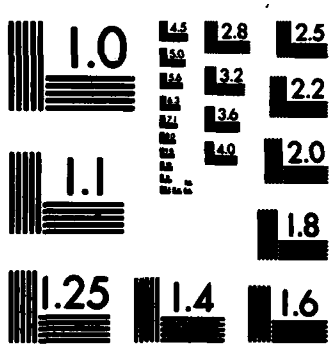

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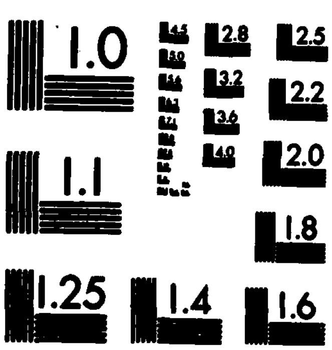

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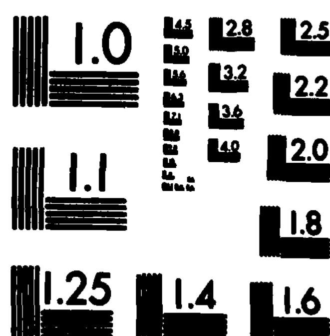

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FANSHAPED SUPERRADIANCE OF A DYE LASER

by

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FANSHAPED SUPERRADIANCE OF A DYE LASER

Wang Xipo, Peng Guifang

Abstract: In this paper we report the fanshaped superradiance of the dye laser achieved by using second harmonics from a giant pulsed YAP:Nd^{3+} laser oscillator-amplifier to pump Rhodamine 6G.

In July, 1980, Professor Chen Ruiliang of Laval University in Canada came and gave lectures to us and introduced a recent Hungarian invention - the fanshaped laser. Recently, based on Professor Chen's introduction, we also achieved fanshaped superradiance of a dye laser. Since emissions of this kind of laser beam assume a fan shape which is planar and since it is amplified spontaneous emission, it is called a "fanshaped laser" or "fanshaped superradiance of a dye laser".

The experimental apparatus with which we achieved fanshaped superradiance of a dye laser is shown in Fig. 1.

Fig. 1. Experimental apparatus for dye laser fanshaped superradiance

KEY: 1. Total reflecting dielectric film (1.079μm); 2. Single 45° $LiNbO_3$ electrooptical Q-switching crystal; 3. Yttrium aluminate (YAP:Nd^{3+}) laser rod ϕ5 X 55mm; 4. Flat glass output plate; 5. Optical isolator; 6. YAP laser amplifying rod ϕ6 X 70mm; 7. Frequency doubling (SHG) $LiIO_3$ crystal; 8. Dichromatic film, for the fundamental wave (1.079μm) total reflection, for the harmonic (0.539μm) T=90%; 9. Right-angle prism; 10. Dye reservoir.

The laser device employs a single 45° $LiNbO_3$ electrooptical

Q-switching yttrium aluminate laser as the oscillation stage, and after one stage of yttrium aluminate laser amplification, it puts out a laser peak power of approximately 30MW, with a repetition rate of once per second; using $LiIO_3$ (I type phase matching, $\theta m \approx 30^{o}$) outer cavity frequency doubling, it puts out 0.539μm frequency doubled light, with a peak power of 1.8MW; and then using 0.539μm frequency doubled light to pump Rhodamine 6G laser dye, we achieved fanshaped superradiance of a dye laser.

In our experiments, the dye reservoir was an ordinary glass tube with a diameter of 12mm and a wall thickness of 1mm which had been made into a cylinder. It held Rhodamine 6G laser dye in an ethyl alcohol solution with a concentration of either 1.1×10^{-4} gram moles/liter or 1.1×10^{-3} gram moles/liter. The pumping light was pumped in through the bottom of the dye reservoir. Since at a very high pumping rate (pulse pumping duration <10ns) the laser gain is sufficiently high, the major portion of the photon emission goes into an amplified spontaneous emission mode, that is, forms superradiance. As a result, the output is two symmetrical fanshaped, planar beams of light as shown in Figures 2 and 3.

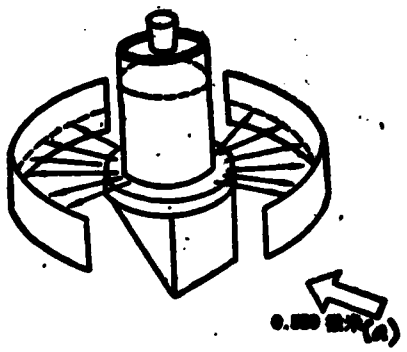
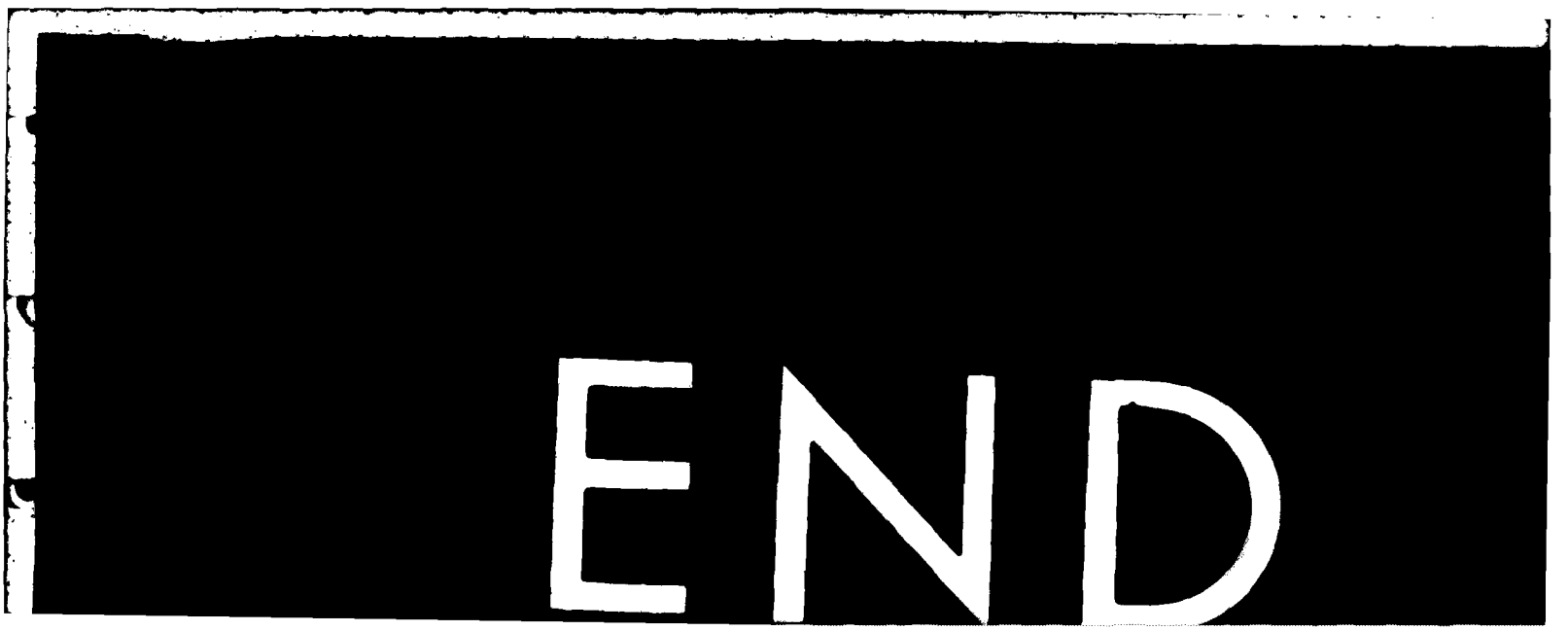


Fig. 2. Schematic diagram of dye laser fanshaped superradiance
KEY: (a) μm

Fig. 3. Photograph of fanshaped superradiance of a dye laser.

The achievement of this kind of laser beam can be expected to have some specific uses in a number of fields.

Changchun Institute of Applied Chemistry, Chinese Academy of Sciences
Submitted 14 July 1981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